Revue d'économie industrielle

143 | 3e trimestre 2013
Varia

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Lamia Ben Hamida and Lucia Piscitello

OpenEdition Journals

Electronic version
URL: http://journals.openedition.org/rei/5613
DOI: 10.4000/rei.5613
ISSN: 1773-0198

Publisher
De Boeck Supérieur

Printed version
Date of publication: 15 November 2013
Number of pages: 11-33
ISBN: 978-2-8041-8484-1
ISSN: 0154-3229

Electronic reference
Lamia Ben Hamida and Lucia Piscitello, « The impact of foreign R&D activities on the MNC's performance at home: evidence from the case of Swiss manufacturing firms », *Revue d'économie industrielle* [Online], 143 | 3e trimestre 2013, Online since 16 December 2015, connection on 01 May 2019. URL : http://journals.openedition.org/rei/5613 ; DOI : 10.4000/rei.5613

THE IMPACT OF FOREIGN R&D ACTIVITIES ON THE MNC'S PERFORMANCE AT HOME: EVIDENCE FROM THE CASE OF SWISS MANUFACTURING FIRMS*

Lamia Ben Hamida, University of Applied Sciences//HES-SO,
La Haute-École de Gestion Arc
Lucia Piscitello, Politecnico di Milano, Dipartimento di Ingegneria Gestionale

Mots clés : Internationalisation de la R&D, recherche des connaissances, exploitation des connaissances, productivité.

Keywords: Internationalization of R&D, Knowledge Seeking R&D, Knowledge Exploiting R&D, Productivity.

1. INTRODUCTION

Multinational corporations (MNCs) are increasingly considered to be the main conduit of new technologies between countries. It is generally assumed to possess the advanced technology (production technology, marketing and management technique, etc.) they tend to exploit in many host countries and, consequently, other firms, particularly the host country's, expect to learn from this technology so as to get the necessary strength to face the foreign competition.

Recent statistics confirm an increasing degree of R&D internationalization by MNCs (Belderbos & Sleuwagen, 2007; UNCTAD, 2005; SFSO, 2010; OECD, 2010; Dachs et al., 2012). At the same time, the recent trend in the outsourcing of intellectual labor has given rise to the fear in European countries,

* This paper is supported by the Swiss National Science foundation grant.

and developed market economies in general, that they stand to lose their comparative advantage in knowledge intensive products as new countries emerge with the basic capabilities needed to provide some technology-based services. This phenomenon has been amplified by the shift from traditional competence exploiting (home base exploiting) foreign R&D activities (i.e. associated with adaptation and modification of existing technological assets to local demand conditions) to the competence creating (home base augmenting) ones, where MNCs 'tap into' local technical and scientific infrastructures (Cantwell & Mudambi, 2005; Kuemmerle, 1999; Pearce, 1999).

The resultant increase in cross border knowledge flows, both intra-MNC and between different innovation systems, involves both technology transfer from headquarters to foreign subsidiaries and "reverse" technology transfer from foreign R&D units to domestic operations and between subsidiaries (Ambos et al., 2006; Criscuolo et al., 2005; Håkanson & Nobel, 2001; Yang et al., 2008). Existing studies so far have largely analyzed the traditional knowledge transfer from parent company to foreign affiliates whereas a very little attention has been given to reverse knowledge transfer from the affiliates to the parent company in the home country. This scarce evidence could be to some extent explained by the fact that the effect of the reverse knowledge transfer is much more difficult to assess since it does not occur automatically but depends on a number of factors, mainly, the MNC's type of motives for performing foreign R&D activities. It is argued that the effect of the MNCs' internationalisation of R&D activities on their performances at home should be differentiated by knowledge/asset-exploiting activity and knowledge/asset-augmenting activity and that the effect is more likely to occur when MNCs invest abroad to augment their existing knowledge/assets (Ben Hamida & Piscitello, 2008).

MNCs focusing on investing in R&D in foreign industry with leading technologies are highly likely to result in transferring the valuable foreign technology to home country[1]. Thus, by investing in knowledge/asset-seeking FDI (competence creating foreign R&D activities), the MNC explicit motive is to gain access to new technologies from the host country (Dunning & Narula, 1995), raising its innovative capacity, its productivity, and consequently its competitive advantage, mainly by means of reverse

1 MNCs tend to locate production or R&D in "centers of excellence" abroad (Cantwell, 1989).

knowledge transfer when host country's technology is transferred from foreign affiliates back to the parent company or to the other sister units (Piscitello & Rabbiosi, 2005). Foreign R&D investments from knowledge-seeking motivation tend then to complement (and thereby strengthen) the R&D activities conducted by the MNC at home (Kotabe, 1990; Piscitello & Santangelo, 2008), and that may lead to a productivity growth at the parent company level (Ben Hamida & Piscitello, 2009).

Within this context, the present paper aims at shedding some light on the empirical effect of the MNCs' foreign R&D activities on their productivity growth at home. Hence, it tends to propose some components for a research agenda on the effect of the reverse knowledge transfer from foreign affiliates to parent company. In order to do that, we rely on firm-level data stemming from the Swiss Innovation Surveys (2008 and 2005), which is conducted at the Swiss Institute for Business Cycle Research "KOF". Switzerland is an interesting case study since Swiss MNCs are increasingly investing in R&D abroad (Hollenstein, 2008). According to the SFSO (2010), the R&D expenditures of the foreign affiliates of Swiss MNCs increased by 64% over four years (between 2004 and 2008) to reach a record of 15.8 billion francs – they even surpassed the R&D expenditures at the parent companies (12.0 billion francs in 2008). Moreover, knowledge/asset-augmenting R&D activities of Swiss MNCs have a stronger tendency to increase than the knowledge/asset-exploiting activities (Michel, 2008). In turn, we expect that at least some of the potential benefits of such investment would be captured by the parent company, raising its productivity at home.

Specifically, our econometric results show that foreign R&D activity of Swiss MNCs is increasingly a valuable source of knowledge raising it productivity growth at home, but only when firms invest in knowledge/asset-seeking R&D.

The structure of the paper is as follows. Following this introduction, section 2 analyzes the theoretical framework underlying our hypotheses, together with a review of the relevant empirical studies. Section 3 discusses the Swiss data and gives some insights about the extent of the R&D activity of Swiss MNCs at foreign locations. Section 4 presents the econometric model. Section 5 presents the estimation results, and section 6 concludes the paper.

2. CONCEPTUAL FRAMEWORK AND HYPOTHESES

MNCs do not pop up randomly in foreign countries. They constantly attempt to increase their profits over time and choose to undertake foreign R&D investment in locations where their long-term profitability is expected to be improved. Diverse factors mediate the choice of a foreign location and motivate an MNC to invest: The resource-seeking and market-seeking investment approaches, which were the first motives for foreign investment, and the efficiency-seeking and strategic asset or capability-seeking investment, which came out in 1960 (Behrman, 1972; Dunning, 1992)[2].

As noted in Narula (2003), the first three kinds of investment can represent motives which are primarily asset exploiting in nature, while the strategic asset-seeking investment represents an asset augmenting activity whereby firms choose to acquire additional assets over their existing ones to protect their long-term competitive power. It is largely argued that MNC foreign activities, as a mean of exploiting its existing knowledge abroad, actively contribute to the transfer of new technologies to the host country, while MNC activities as a mean of acquiring a host country's knowledge contribute to the reverse technology transfer from foreign units to domestic activity and between subsidiaries (Ben Hamida & Piscitello, 2008; Frost, 1998; Monteiro et al., 2008; Zhou, 2002).

Recent literature suggest that the MNC foreign expansion can be regarded not only as a way to internally exploit its existing ownership advantage on a host market (Buckley & Casson, 1976; Hymer, 1960), but also as a way to absorb local knowledge and then build new firm-specific advantage (Kuemmerle, 1999). Thus, by investing in knowledge/asset-seeking R&D, the MNC's explicit motive is to gain access to new technologies (e.g. innovative capacities, managerial and organizational knowledge, intangible resources, a better comprehension of the local customers) from the host country (Dunning & Narula, 1995), raising its productivity performance in the home country. It emerges then that MNCs in the home country may gain benefit from reverse technology transfer (RKT) which could increase

2 A detailed analysis of the four motives of foreign investment is presented in Ben Hamida (2007).

their productivity performance at home (Ben Hamida & Piscitello, 2009; Piscitello & Santangelo, 2008).

Despite these strong arguments supporting that MNCs' R&D operations in foreign locations may positively influence their productivity growth at home, evidence on the effect of this reverse knowledge transfer from the affiliates to the parent company is still very scarce. To some extent this could be explained by the fact that this kind of effect is difficult to assess since it depends on a number of factors, mainly, the MNC's motives for performing foreign R&D. Thus, the effect of the MNCs' internationalization of R&D activities on their performances at home should be differentiated by knowledge/asset-exploiting activity and knowledge/asset-augmenting activity, and the effect is more likely to occur when MNCs invest abroad to augment their existing knowledge/assets (Ben Hamida & Piscitello, 2008).

Existing studies have mainly focused on the factors explaining the reverse knowledge transfer from foreign affiliates to the parent company. Giroud et al. (2009) analyzed the role of the characteristics of the affiliate and the characteristics of its relationship with the parent company, and demonstrated that the willingness and transmission channels are among the main indicators of reverse knowledge transfer within the context of knowledge intensive British services[3]. That is the more the affiliate is willing to transfer its knowledge and the more the formal and informal transmission channels are employed, the more the affiliate will engage in the process of reverse knowledge transfer.

The role of the characteristics of the relationship between foreign affiliates and the MNC parent company has also been investigated in previous studies such as Håkanson and Nobel (2001) who examine the role of the closeness of the relationship between the foreign affiliate and the parent company in promoting RKT found that integration – used to show the strength of the relationship – is one of the key factors. In line with the importance of the affiliates' characteristics in explaining RKT, Gupta and Govindarajan (2000) showed that the existence and richness of transmission channels contribute significantly to the knowledge transfer from

3 The significant role of the affiliate's motivation to transfer its knowledge to the parent company is also highlighted in Schulz (2001) and Foss and Pedersen (2002), among others.

and to the affiliates. Recently, Blomkvist (2009) examined the role of the entry mode and found that the pace of knowledge diffusion from foreign affiliates to the parent company is more rapid for acquired than greenfield foreign affiliates.

Theory and evidence on MNCs (Almeida, 1996; Cantwell, 1995; Dunning, 1998; UNCTAD, 2001, 2005) has traditionally acknowledged that FDI are more and more selectively tapping knowledge in specific host markets when designing their global knowledge sourcing strategies. Specifically, the increased role of geographically dispersed sourcing of technology through the international networks of globally integrated MNCs has led to a growing interest in the asset-acquiring motive for FDI (Cantwell & Piscitello, 2000; Tallman & Yip, 2001)[4]. According to this knowledge-seeking argument, firms may expand abroad in search of capabilities complementary to those available in their home markets (Cantwell, 1989). This suggests that firms use knowledge-seeking investments also to source technical diversity and knowledge developed abroad, which can be transferred back to the parent company (Mudambi et al., 2013) or other sister units, raising their innovation performance, their productivity, and consequently their competitive advantage (Cantwell & Piscitello, 1999; Griffith et al., 2004; Piscitello & Rabbiosi, 2006).

The above discussion raises the following hypotheses:

H1: R&D activities conducted abroad will have positive effects on the MNC parent company's productivity.

H2: Effects on productivity will be higher if R&D activities conducted abroad are of a knowledge/asset-seeking type.

4 It is becoming recognized that the observed decentralization in the management of international R&D can be related to the capture of 'home base augmenting' benefits (Kuemmerle, 1999; Papanastassiou & Pearce, 1997).

3. THE DATA

Before introducing our empirical model, it is worth giving some insights about the extent of the R&D activity of Swiss MNCs at foreign locations relative to that conducted at home.

In this context, Hollenstein (2008) stated that, during the last three decades, the level of the internationalization of Swiss firms' innovative activity (R&D here) strongly increased. It increased by 64% between 2004 and 2008, in terms of R&D expenditures and even surpassed the domestic R&D expenditures in 2008 (SFSO, 2010). This seems to be confirmed by Michel's study (2007) that, based on the analysis of patents of 71 Swiss MNCs issued between 1978 and 2006, found that Swiss MNC patents generated in foreign affiliates amounted to 43.6 percent of the total Swiss MNCs patents in the 1980s, grew up in the 1990s to reach 54 percent and 61.8 into 2000-2006. In contrast, the inventions of Swiss MNCs made at home have grown at a lower rate than their overall inventions. Also, Le Bas and Sierra (2002) found that in 1994-1996 about 60% of Swiss MNCs' patents of 13 firms are based on research activities undertaken abroad.

Table 1 presents the percentage share of Swiss manufacturing MNCs performing overseas R&D into 2006-2008, by sector and type of R&D motives[5]. Table 2 reports the sectoral share of Swiss firms' R&D abroad, part of their whole R&D investment, in 2004 and 2007 (percent). The data for these tables come from the innovation activity survey (2005 and 2008) of manufacturing firms, with at least 5 employees and providing a full coverage of large firms, conducted at the Swiss institute for business cycle research "KOF"[6]. The survey was based on a stratified sample of firms according to the industry affiliation and the industry-specific firm size classes. Individual information covers the technological behavior of 1262 manufacturing firms – 166 performing R&D abroad – within the period 2003-2005 and 1069 firms – 146 performing R&D abroad – within the period 2006-2008. Our calculations are based on weighted data sets so as to give a

5 Following Narula (2003), the motives considered in this paper are classified into knowledge-seeking R&D and knowledge-exploiting R&D.

6 Questionnaires can be downloaded from www.kof.ethz.ch, but the firm-level data are unpublished and highly confidential.

representative picture of the Swiss economy – the weights are used to correct for the selection bias resulting from "unit" non-response and for the deviations of the sample structure from that of the underlying population.

In general, the share of Swiss manufacturing MNCs performing R&D abroad is about 15% indicating that at the aggregate level Swiss firms do not seem to largely invest in foreign R&D activity. This share seems to be equally distributed between R&D knowledge-seekers and R&D knowledge-exploiters. However, across sectors this result changes considerably; that is, in some sectors the share of Swiss MNCs investing in foreign R&D becomes large as in pharmaceuticals, plastics, and communication equipments. While in others it remains small, particularly in metalworking, wood products, textiles, and food. In addition, firms in sectors such as textiles, plastics, metal production, and electrical machinery appear to invest more in knowledge-exploiting R&D while firms in chemicals, pharmaceutical, and non-metal mineral products invest more in knowledge-seeking R&D. There are also sectors (e.g. tobacco, food, and watches) wherein the share of firms investing in knowledge-seeking R&D remains as much as that of firms performing knowledge-exploiting R&D.

Regarding the share of Swiss firms' R&D in foreign locations relative to that at home, table 2 reports that this share is equal to 26 percent in 2004 and hides significant differences across sectors, that is it recognizes a substantial increase up to 63 percent in paper, followed by chemicals, watches and transport equipments, while in other sectors it falls by as much as 7 percent in non-metal mineral products and 9 percent in metalworking. In 2007, the share of foreign R&D investment within Swiss MNCs slightly decreased to 20 percent. This decrease results from the fact that firms in most manufacturing sectors (12 of sectors) recognized a sharp decrease in the share of their foreign R&D investment. These sectors are mainly paper, transport equipments, and chemicals. Nonetheless, it is also noteworthy that firms in other sectors such as pharmaceuticals and watches increased their R&D investment level in foreign locations, marking that R&D activity in these sectors is no longer centralized at the home.

Table 1. Share of Swiss manufacturing MNCs performing overseas R&D during the period 2006-2008: Sectoral share by type of R&D motive (percent)

Sector	OutR&D	OutR&D Knowledge-seeking R&D[a]	OutR&D Knowledge-exploiting R&D[b]
Manufacturing	15.3	4.9	5.3
Food	9.8	0.9	0.8
Tobacco	47.4	47.4	47.4
Textiles	8.4	2.1	4.2
Wood products	8.5	8.5	8.5
Chemicals	25.5	12.1	8.4
Pharmaceuticals	42.0	19.6	8.4
Plastics	34.8	0.0	9.5
Non-metal mineral products	23.2	18.4	0.0
Metal production	20.2	0.0	7.9
Metalworking	8.8	3.3	3.0
Machinery	21.2	4.8	6.4
Electrical machinery	26.4	2.8	9.5
Communication equipments	26.6	12.9	13.7
Medical instrument	21.5	4.7	6.2
Watches	6.2	6.2	6.2

OutR&D denote foreign R&D
a: share of Swiss MNCs assessing knowledge-seeking R&D as an important motive (value 4 or 5 on five-point Likert scale)
b: share of Swiss MNCs assessing a knowledge-exploiting R&D as an important motive (value 4 or 5 on five-point Likert scale)
Source: Author's calculations of data derived from KOF innovation surveys (2008).

Table 2. Sectoral share of Swiss firms' R&D abroad, part of their whole R&D investment, in 2004 and 2007 (percent)

Sector	2004	2007
Manufacturing	25.9	19.2
Food	11.1	13.1
Textiles	18.2	13.5
Wood products	35.9	40
Paper	63.1	9
Chemicals	46.7	21.8
Pharmaceuticals	14.1	49.5
Plastics	14.7	3.1
Non-metal mineral products	7.5	22
Metal production	11.7	9.8
Metalworking	9.4	27.1
Machinery	27.3	16.4
Electrical machinery	14.8	13
Computer and office equipments	29.8	25
Communication equipments	16.5	14.4
Medical instrument	19.9	15.3
Watches	42.5	70
Transport equipments	40	16.4
Other manufacturing	33.5	2.4

Source: Author's calculations of data derived from KOF innovation surveys (2005 and 2008).

In this context, testing whether MNCs' foreign R&D investment may increase the productivity performance of the parent companies at home is the focal point of our empirical analysis discussed in following sections. In particular, we test econometrically the effect of the Swiss MNCs' internationalisation of R&D activities on their productivity growth at home, while controling for the influence of the motives for performing foreign R&D investment.

4. ECONOMETRIC MODELS AND VARIABLES

We test for the effects of the foreign R&D activity of Swiss MNCs on their productivity growth in the home country, in which the labor productivity

growth of firm i between 2004 and 2007 is a function of its foreign investment in R&D in 2004 as follows[7].

$$\Delta Labor\_pdty_{ij} = a_0 + a_1 Foreign\ R\&D_{ij} + a_2 Size_{ij} + a_3 Investment_{ij} + a_4 Pdty\ GAP_{ij} + a_5 FP_j + a_6 FOR_{ij} + a_7 Nat - Incentives_{ij} + \alpha_8 Industry_j + u_i \quad (1)$$

Where Δ represents changes in the variables between 2004 and 2007, the subscripts i and j denote firm and industry, respectively.

– $Labor\_pdty_{ij}$ is the firm's labor productivity measured by the ratio of the firm's added value to the number of its employees. $Labor\_pdty_{ij}$ is used to assess the response of the firm in terms of productivity growth. Positive and significant impact of foreign R&D on labor productivity would imply that domestic employees at the parent company have succeeded in absorbing and learning foreign R&D. We consider labor as the main channel of knowledge transfer within the MNC and we expect foreign R&D activities will have strong and positive impact on firm's labor productivity[8].

– $Foreign\ R\&D_{ij}$ is the measure of the firm's foreign activity in R&D in industry j. It is a dummy variable with the value of 1 if the firm i in industry j performs foreign R&D in 2004, and 0 otherwise. This measure allows for the differences in productivity growth between firms investing and firms not investing in foreign R&D. It is assumed to determine the effect of the foreign R&D investment of Swiss MNCs on their productivity performance at home.

– FOR_{ij} is a dummy variable used to control if the firm i in the industry j is foreign-owned or domestic.

The literature suggests the use of other firm's characteristics such as the size and the absorptive capacity, since they may influence the productivity growth of the firm. Larger firms may be more efficient and hence they

7 Table 3 details the variables and their measurements, table 4 reports their descriptive statistics, and table 5 shows their Pearson correlations.

8 Total factor productivity could be also a good measure of firm productivity; unfortunately available data does not allow its measurement.

should take more advantage of innovations (Dimelis & Louri, 2002; Meyer & Sinani, 2004). The concept of absorptive capacity encompasses the firm's ability to recognize valuable new knowledge, integrate it into the firm and use it productively. The firm's level of absorptive capacity depends upon its existing level of technological competence as well as the learning and investment efforts it makes so as to be able to use foreign knowledge productively (Ben Hamida & Gugler, 2009; Narula & Marin, 2003). Firms that have achieved competitive technological levels at home and possess a sufficient level of absorptive capacity in terms of learning and investment efforts are more able to make productive use of foreign knowledge (Ben Hamida & Gugler, 2008; Cantwell, 1989; Cohen & Levinthal, 1990). In addition, Yang et al. (2008) state that firms with more available relevant knowledge would like to invest more in foreign R&D to absorb external knowledge.

– $Size_{ij}$ is the measure of the firm's size, defined as the change between 2004 and 2007 in the number of its employees.

– $Pdty\ GAP_{ij}$ is the measure of the technological capacity of the firm i. It is measured by the difference between the firm's own labor productivity and the average labor productivity in its industry j in 2004.

– $Investment_{ij}$ is a dummy variable that is equal to 1 if the level of investment expenditures in new equipment and training activities for product/process innovation, within the period 2006-2008 is greater than 3, and 0 otherwise. The firm's level of investment expenditures is calculated based on a five-point Likert scale.

In addition, as the literature on MNCs has acknowledged the importance of spillovers stemming from the presence of foreign actors in a geographical area (for a recent survey, see Ben Hamida & Gugler, 2009 and Castellani & Zanfei, 2006), we also control for the presence of foreign affiliates at home.

– FP_j is the measure of foreign presence, calculated for each industry as the ratio of the foreign firms' sales to total sales in 2004.

The inclusion of industry dummies[9], Industry_j, in equation (1) and the use of changes over time, control for the industry-specific productivity differences; they correct for the omission of unobservable variables that might undermine the relationship between the foreign R&D activity of the firm and its productivity growth at home (Aitken & Harrison, 1999; Narula & Marin, 2003)[10].

Finally, we control whether the firm investing abroad benefits from national public financial incentives. Doing so, we might examine the role of national institutions in increasing the productive capacity of the firm.

– $Nat-Incentives_{ij}$ is a dummy variable indicating whether firm i affirms that it has drawn advantages from national public financial incentives within the period 2006-2008.

To test our hypothesis H2, the size and the extent of the effect of the foreign R&D activity of Swiss MNCs on their productivity growth may vary according to the diverse types of motives for foreign R&D investment, we built two separate dummy variables: $Know\_seekingR\&D_i$ and $Know\_exploitingR\&D_i$ taking the value of 1 if the firm performs knowledge-seeking R&D or knowledge-exploiting R&D, respectively. We use Narula's (2003) classification to distinguish between knowledge-seeking and knowledge-exploiting R&D. As we noted previously, resource-seeking, market-seeking, and efficiency-seeking investment represent motives which are primarily knowledge exploiting in nature, while the strategic asset-seeking investment represents knowledge seeking R&D investment. KOF data available allows for this kind of distinction. Thus:

– $Know\_seekingR\&D_i$ is a dummy variable equals to 1 if the firm i in the industry j assesses knowledge-seeking R&D as an important motive in 2004 (value 4 or 5 on five-point Likert scale), 0 otherwise.

9 There are 18 industry dummies accounted for manufacturing.

10 The use of first differences between two time periods with a time lag of three years will control for fixed differences in productivity levels across industries (Dimelis, 2005; Narula & Marin, 2003).

– $Know\_\exp loitingR\&D_i$ is a dummy variable equals to 1 if the firm i in the industry j assesses knowledge-seeking R&D as an important motives in 2004 (value 4 or 5 on five-point Likert scale), 0 otherwise.

We test equation (1) using KOF data derived from the surveys of 2005 and 2008. Because of missing data for some variables when matching the two data sets of the surveys, the regression analyses make use of a sample of only 245 manufacturing firms wherein 41 firms investing in foreign R&D investment.

All regression results are robust and refer to OLS estimations of equation (1).

Table 3. Variable definitions

Variables	Definitions
$\Delta Labor\_pdty_{ij}$	The change in labor productivity at the firm level.
$ForeignR\&D_{ij}$	A dummy variable equals to 1 if the firm i in the industry j performs foreign R&D in 2004, 0 otherwise.
$Know\_seekingR\&D_i$	A dummy variable equals to 1 if the firm i in the industry j performs knowledge-seeking R&D in 2004, 0 otherwise.
$Know\_\exp loiting\ R\&D_i$	A dummy variable equals to 1 if the firm i in the industry j performs knowledge-exploiting R&D in 2004, 0 otherwise.
$Size_i$	The change between 2004 and 2007 in the number of the firm's employees.
$Investment_i$	A dummy variable equals to 1 if the firm's level of investment expenditures in new equipment and training activities for product/process innovation, within the period 2006-2008 is greater than 3, 0 otherwise. The firm's level of investment expenditures is calculated based on a five-point Likert scale.
$Pdty\ GAP_i$	The difference between the firm's own labor productivity and the average labor productivity in its industry j, calculated for 2004.
FP_j	The ratio of the foreign firms' sales to total sales in 2004.
$Nat-Incentives_i$	A dummy variable indicating whether or not the firm affirms that it has drawn advantages from national public incentives within the period 2006-2008.
FOR_i	A dummy variable used to control if the firm i in the industry j is foreign-owned or domestic in 2007.

Table 4. Descriptive statistics of some regression variables

Variables	Full sample of firms		Only firms performing foreign R&D	
	Mean	S.D.	Mean	S.D.
$\Delta Labor\_Pdty_{ij}$	0.15	0.54	0.08	0.37
$Foreign\ R\&D_{ij}$	0.18	0.38		
$Know\_seeking\ R\&D_i$			0.24	0.42
$Know\_exploiting\ R\&D_i$			0.22	0.41
FOR_{ij}	0.18	0.39	0.3	0.46
$Size_{ij}$	0.29	2.1	0.26	1.16
FP_j	23.4	18.5	29.3	2.4

Table 5. Pearson correlations of regression variables using only firms performing foreign R&D

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) $Labor\_pdty_{ij}$	1.00								
(2) $Know\_seekingR\&D_i$	0.27*	1.00							
(3) $Know\_exploiting\ R\&D_i$	-0.12	-0.3***	1.00						
(4) $Size_i$	-0.02	-0.11	0.20	1.00					
(5) $Investment_i$	0.05	0.001	0.08	0.03	1.00				
(6) $Pdty\ GAP_i$	-0.45***	-0.13	0.13	0.17	-0.01	1.00			
(7) FP_j	-0.18	-0.12	0.18**	0.06	0.13	0.07	1.00		
(8) $Nat-Incentives_i$	-0.06	-0.17	0.04	-0.08	-0.06	0.26*	0.07	1.00	
(9) FOR_i	0.08	-0.14	0.28	0.21	0.02	-0.16	0.25**	0.006	1.00

*, **, and *** denote the significance level of the correlation coefficients at the 10%, 5%, and 1% levels, respectively.

5. EMPIRICAL FINDINGS

The growth model presented in section 3 is firstly estimated using the full sample of multinational firms, and secondly using the sub-sample of firms performing foreign R&D. Estimations are carried out with the method of ordinary least squares using cross-sectional firm-level data and various robustness tests are performed. The main problem that could arise is the potential endogeneity between inputs and productivity. To allow for this problem, a two-stage least squares (2SLS) method was tried using as instruments the level variables at the year 2004. A Hausman test was performed to check the potential endogeneity (Hausman, 1978). This test evaluates the significance of an estimator versus an alternative estimator (OLS versus 2SLS in this case). The results indicate that OLS is preferred over 2SLS at the 5 percent level of significance.

Regression 6.1 in table 6 shows the results of the effect of MNCs' foreign R&D investment on their productivity growth in the home country using the full sample of manufacturing firms. The estimated coefficient of the variable $Foreign\ R\&D_{ij}$ is negative and not significant, showing that firm's productivity growth between 2004 and 2007 at home seems to not been positively determined by its own foreign R&D investment in 2004[11]. This result does not support our hypothesis H1. The absence of a positive and significant effect of foreign R&D activities in Swiss manufacturing firms, when taking all the firms together, appears to indicate that this effect might be determined by the firms' heterogeneity in terms of the type of R&D motives as was arguably suggested by among others (Ben Hamida & Piscitello, 2009; Cantwell & Piscitello, 1999; Griffith et al., 2004; Mudambi et al., 2013; Piscitello & Rabbiosi, 2006).

Firms' characteristics do not seem to have any significant effect on domestic productivity performance of all firms, except the size as larger firms see to take more advantage of innovations, and the technological gap which is in line with the advantages of the backwardness hypothesis. The presence of foreign firms in the industry does not seem to have significant positive spillover effects.

11 Table 7 summarizes our hypotheses and their corresponding estimated results.

In regressions 6.2, we tested the effect of the RKT on the productivity growth of Swiss MNCs and its relationship with the type of the R&D motives (knowledge-seeking R&D and knowledge-exploiting R&D). To do so, we replace the variable $Foreign\ R\&D_{ij}$ by two separate dummy variables, $Know\_seekingR\&D_i$ and $Know\_exploitingR\&D_i$ and we remove from our sample the firms that are not investing in foreign R&D in order to focus on the response of Swiss MNCs to the RKT process. Our results change considerably wherein significant positive effects occur for firms performing knowledge-seeking R&D and negative effects occur for firms investing in knowledge-exploiting R&D. In fact, the estimated coefficient for $Know\_seekingR\&D_i$ is positive and highly significant whereas $Know\_exploitingR\&D_i$ remain negative and insignificant. This result could be interpreted as reflecting that, as expected, firms performing knowledge-seeking R&D manage to fully exploit the technological opportunities arising from their investment in foreign locations by increasing their productivity performance. This finding corroborates our hypothesis H2.

The estimated coefficient of the technological gap remains negative confirming the Findlay's (1978) theory. Other firms' characteristics remain insignificant. FP_j is negative and significant in regression 6.2 showing that foreign presence does not have any positive effect on the firms' productivity growth in Switzerland. This can be explained by the fact that the variable we used to measure the benefit of inward foreign direct investment in Switzerland does not seem appropriate to capture the whole information on the ways this effect occurs (Ben Hamida & Gugler, 2007; Ben Hamida, 2011) or that the assessment of this benefit requires a detailed analysis of the effect regarding the technological characteristics of local firms, such as their absorptive capacity. Regarding other regression variables, the results are quite similar to regression 6.1.

Table 6. Estimation results for manufacturing: the role of foreign R&D motives

Variables	Full Sample (6.1)	Only firms performing foreign R&D (6.2)
$Foreign\ R\&D_i$	-0.02 (0.13)	
$Know\_seekingR\&D_i$		0.47* (0.26)
$Know\_\exp loiting\ R\&D_i$		-0.14 (0.24)
$Size_i$	0.23* (0.14)	0.003 (0.32)
$Investment_i$	-0.17 (0.11)	0.21 (0.21)
$Pdty\ GAP_i$	-0.9*** (0.23)	-1.2* (0.66)
FP_j	-0.01 (0.09)	-0.42** (0.19)
$Nat-Incentives_i$	-0.03 (0.16)	0.09 (0.28)
FOR_i	0.13 (0.12)	-0.29 (0.23)
$\overline{R}^2$	0.083	0.34
Hausman statistic	2.12	2.45
N	245	41

All standard errors, in parentheses, are corrected for heteroskedasticiy.
*, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 7. Hypotheses and estimated results

Hypotheses	Regressions	Support (S)/not support (N)
H1	(6.1)	N
H2	(6.2)	S

6. CONCLUSIONS

This paper addresses the effects of FDI in R&D on the productivity performance of the Swiss MNCs at home. It hypothesizes that the foreign R&D activity of MNCs would positively affect their productivity growth at home, and that this effect depends largely on the type of R&D motives. Many have studied the traditional knowledge transfer from the parent company to foreign affiliate, but there is still scarce evidence on the effect of reverse knowledge transfer from the foreign affiliates to the parent company at home.

Based on a sample of Swiss manufacturing firms, we show that it is important to take account of the type of R&D motives when evaluating the effect of the MNCs' internationalisation of R&D activities on their productivity growth at home. That is, taking all the firms together the results do not reveal significant effect, so foreign R&D investment of MNCs does not seem to enhance their productivity growth at home. However, removing from the sample the firms that are not performing foreign RD and introducing in equation (1) two separate variables for knowledge-seeking and knowledge-exploiting R&D yields differences in results. In fact, we find that foreign R&D activity of Swiss MNCs is increasingly a valuable source of knowledge which positively affects their productivity growth of the parent company activity only when firms perform knowledge-seeking R&D. However, when firms invest in knowledge-exploiting R&D, productivity growth at home decreases in response with the share of the foreign R&D investment. These findings underline the importance of controlling for the firms' characteristics regarding R&D motives when assessing the effect of the MNCs' internationalisation of R&D activities on the productivity performance of the parent companies.

On the policy front, these findings support the actions to motivate foreign R&D activity of Swiss MNCs; however, suggestions with respect to encouraging FDI in R&D following such findings must take into account that knowledge-seeking R&D should significantly contribute to the productivity growth of the parent company. Actions should then promote foreign affiliates' ability to engage in knowledge-seeking R&D and then transferring local knowledge to parent company in the home country.

A future research aiming to analyze other determinants (such as the characteristics of knowledge, the location of foreign R&D, etc.) of the effect of the MNCs' internationalisation of R&D activities on their performances/ productivity at home is certainly promising. For example, Yan et al. (2008) suggest that knowledge relevance could help parent firms pay attention to the new knowledge of affiliates and recognize the potential benefits. The more their knowledge overlaps, the more likely the parent takes interest in the affiliate's knowledge and understands its benefits.

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